

Possible Identification of a "Organized Element"
in Orgue Meteorite

Abstract. Ragweed pollen stained by the Gridley method becomes distorted so that it resembles Claus and Nagy's Type 5 organized element, a particle found in a Gridley stained preparation of the Orgueil carbonaceous chondrite.

One of the most striking apparently biogenic particles, reported from carbonaceous chondrites, is the "Type 5 organized element" (1). It is hexagonal, with tubular projections extending from alternate sides, and is surrounded by a clear halo. It seems to be quite rare. Claus and Nagy (2) found only two such particles (along with several fragments) in Orgueil, and four in Tonk. One of these particles has been illustrated in print (1-4); this particle is the only one which we were able to examine personally and to photograph in Dr. Claus' laboratory. (Fig. 1). It appears on a slide stained with the Gridley method, and is orange-brown in color.

Claus and Nagy pointed out that this particle "is entirely dissimilar in its morphology to known terrestrial form[s]" (1), and suggested that it be recognized as an extraterrestrial genus, Daidaphore berzelii (2). The tubular projections were stated to contain up to 50 filaments. Mueller, on the other hand, has suggested that this particle is a monite pseudomorph after troilite (5). However, hexagonal mineral grains do occur in Type 1 carbonaceous chondrites but do not have tubular projections or a clear halo.

Since the organized elements were reported to stain with various biological stains (1), and since several of the type 2 organized elements appear to be ragweed (6, 7) or other (8, 9) pollen grains,

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we examined the staining properties of various pollen grains. Siegel (10) had previously suggested, on the basis of the trigonal symmetry of the type 5 element, that it might be a distorted pollen grain. The distortion might have been caused by the chromic acid or the Gridley staining procedure, since it is known to have a "violent and disruptive effect" on cells (11). An unexpected finding was that ragweed pollen grains stained with the Gridley method have an appearance strikingly similar to the type 5 organized element.

Pollen from giant, short, western, southern, slender and false ragweed (Ambrosia trifida, A. elatior, A. psilostachya, A. bidentata, Franseria tenuifolia, and F. acanthicarpa) was suspended in Mayer's egg albumin and spread on microscope slides. The naturally shed pollen was untreated except for that from A. psilostachya and A. bidentata which was obtained from dried flowers and had been washed with acetone and carbon tetrachloride (12). The slides were either air-dried, or fixed in alcohol and were then treated with the various reagents used in the Gridley staining procedure in order to determine the effect of each solution alone and in various combinations on the pollen grains. The Gridley stain, originally developed to demonstrate fungi in tissue sections, consists of treatment with 4% chromic acid for 1 hour/^{followed} by reaction with Schiff's reagent and staining with aldehyde fuchsin and metanil yellow (13).

The chromic acid treatment removed the outer part of the exine and apparently caused swelling of the remaining exine. This resulted in some increase in diameter and loss of much of the spiny surface detail of the ragweed pollen grains. The pollen cell was shrunken and the intine was collapsed around it. The intine usually remained attached to the germinal pores. In pollen grains seen in polar view, the intine appeared hexagonal

in outline with short tubular appendages attached to germinal pores protruding from alternating surfaces. (Figs. 2,3). The portion of the intine from which the appendages protruded was apparently thicker so that these walls were smoother, more distinct and thicker. In air-dried smears, the germinal pores frequently were ruptured, and the cell cytoplasm exuded in brush-like or worm-like ribbons up to 20 μ long. Frequently such protrusions extended through two or even all three of the germinal pores. In alcohol fixed slides, such protrusions were quite rare, although the appearance of the intine and cell was otherwise like that found in air-dried preparations.

The exine did not appear to stain with any of the reagents used; the faint yellow color observed on the surface of the pollen grains was probably due to staining by metanil yellow of the egg albumin coating the pollen grain. The intine had a magenta color when reacted with Schiff's reagent after chromic acid treatment; no staining was observed if chromic acid treatment was omitted. Aldehyde fuchsin caused slight purple staining of the intine with or without chromic acid treatment. Metanil yellow produced yellow-brown staining of the cytoplasm but little staining of other components of the pollen grain. However, the intine had a brownish purple color after the complete Gridley stain although it did not appear to stain when treated with metanil yellow alone. The vacuoles and cell nucleus did not appear to stain with the reagents used.

All six species of ragweed examined had a similar appearance after the Gridley stain. Some differences primarily in the shape of the exine were noted, however. A. elatior, A. trifida, and F. acanthicarpa resembled most closely the type 5 organized element. Minor differences were evident in different preparations of the same batch of pollen. It is likely that

minor variations in the staining procedure will slightly alter the final appearance of the stained pollen grains.

It is difficult to be certain of the size of the type 5 organized element. Measurements made from published drawings (1, 2) indicate that the distance from one hexagonal face to the one opposite is 15 to 16 μ and that the diameter of the halo is about 33 to 35 μ . Measurements of our own photomicrographs (Fig. 1) of one type 5 organized element gave 12 μ and 19 to 21 μ for these two dimensions. Measurement of 10 randomly selected pollen grains in an air-dried, Gridley-stained preparation of A. elatior gave a range of 12.9 to 14.5 μ and 17.4 to 19.9 μ respectively. Corresponding dimensions of A. trifida were 13.3 to 14.9 μ and 18.7 to 21.8 μ . Occasional grains were somewhat larger or smaller. The size depends somewhat on the amount of exuded cytoplasm, the grains with the more prominent appendages tending to be smaller. The dimensions of the type 5 organized element appear to be within the range of those of various ragweed pollen grains stained with the Gridley method.

Other pollen grains were also examined after staining with the Gridley method. Alcohol-fixed preparations of white birch and black birch (Betula populifolia, B. lenta) and ironwood (Ostrya virginiana) had a somewhat hexagonal appearance but appendages were not present, and the intine near germinal pores was quite thick. Red cedar and mountain cedar (Juniperus virginiana and J. sabinoidea) retained a spherical shape with central polyhedral markings. The appearance was quite similar to some of the type 2 organized elements, e.g. Fig. 4 in ref. (2).

The Orgueil preparation, in which the original type 5 organized element of Claus and Nagy was found, was definitely stained with the Gridley method.

Although we cannot state with certainty that this particle is in fact a distorted ragweed pollen grain, it resembles Gridley-stained ragweed pollen in size, color and morphology.

This supports the previous contention that morphology alone is not an adequate criterion for proving the extraterrestrial origin of suspected life forms in meteorites (6,7). Gregory has emphasized that one person can be familiar with only a fraction of the morphological diversity of plant spores (9). Even common pollen grains may become so altered as to be unrecognizable when treated in an unfamiliar way.

In the present instance, the resemblance of the type 5 organized element (ot) a common air-borne pollen grain, treated according to a relatively standard biological staining procedure, has gone unnoticed for more than a year. Regardless of its true identity, one can no longer say that the type 5 organized element is entirely dissimilar in its morphology to known terrestrial forms (14).

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14. This work was supported in part by the National Aeronautics and Space Administration.

Figure Captions

Fig. 1. Two views of a type 5 organized element, discovered by Claus and Nagy (1) in a preparation of Orgueil meteorite stained by Gridley method and mounted in Canada balsam. Note halo and brush-like protrusions. The vertical lines at bottom of picture are 10 μ rulings of a stage micrometer, photographed at the same magnification.

Fig. 2. False ragweed (Franseria acanthicarpa) and Fig. 3., short ragweed (Ambrosia elatior) pollen, stained by Gridley method and mounted in Permunt. The distorted central portion of the pollen grains, altered by the staining procedure, is an oblate spheroid, flattened at germinal pores which when seen in polar view appears hexagonal and in equatorial view, oval (S).